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NOVEMBER/DECEMBER 2023

DPH13/GPH13 — QUANTUM MECHANICS -I

Time : Three hours　　　　Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

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Answer ALL questions.

1. What are scattering states?

2. What is meant by tunnelling?

3. Find the value of <H>, given

$$H = \varepsilon \begin{pmatrix} 0 & i & 0 \\ -i & 0 & 0 \\ 0 & 0 & -1 \end{pmatrix} and / \psi_0 >= \frac{1}{\sqrt{5}} \begin{pmatrix} 1 & -i \\ 1 & -i \\ & 1 \end{pmatrix}.$$

4. State the postulates of aurantium mechanics.

5. Differentiate Heisenberg and Schrodinger picture.

6. Interpret the invariance of $\hat{H}$ under conservation laws.

7. When does parity and time reversal occur?

8. Inspect the importance of expectation values.

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9. Assess $\left[\hat{j}^2, \hat{j}_x\right]$

10. Infer Wigner-Eckart theorem.

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions.

11. (a) Elaborate Max Born's interpretation of wave function.

Or

(b) Illustrate the state of the particle confined in a rectangular potential barrier.

12. (a) Analyze the properties of linear vector spaces.

Or

(b) Compile the concept of unitary transformation.

13. (a) Obtain the solution of simple harmonic oscillation by operator method.

Or

(b) Summarize the general view of conservation laws.

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14. (a) Illustrate the description of hydrogen like atoms.

Or

(b) Examine the expectation value of an observable.

15. (a) Outline the salient features of Ladder operator.

Or

(b) Determine the eigen values of J_z.

SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Obtain the eigen value and eigen functions for a particle present in a square well potential.

17. Make use of quantum mechanics, principles to validate Ehrenfest theorem.

18. Derive the Heisenberg equation of motion and discuss its classical limits.

19. Explain reduced density matrix.

20. Formulate Clebsch-Gordan coefficients that arise in angular momentum coupling.
